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Daron Isaac and Micheal Iverson (ATK Thiokol), "Automated Fluid-Structure Interaction Analysis"

Thermal and Fluids Analysis Workshop **(Statement A)**
(NASA Langley, Hampton, VA, 18-22 Aug 2003) **<u>(Deadline: None Listed)</u>**

AUTOMATED FLUID-STRUCTURE INTERACTION ANALYSIS

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ABSTRACT

An automated Fluid-Structure Interaction (FSI) analysis procedure has been developed at ATK Thiokol Propulsion that couples computational fluid dynamics (CFD) and structural finite element (FE) analysis to solve FSI problems. The procedure externally couples a steady-state CFD analysis using Fluent® and a structural FE analysis using ABAQUS®. Pressure results from the CFD solution are interpolated and applied as pressure boundary conditions on the structural FE model. Displacements from the structural analysis are interpolated and applied to the boundary of the CFD mesh. Iteration between the CFD and the structural analysis continues until a solution is reached. The FSI procedure provides controls to monitor the solution and define termination criteria, as well as manage output. Automatic report generation of the solution is another feature of the FSI procedure. Plans and funding are in place to extend the FSI procedure to include coupling with thermal analysis as well.

The FEM Builder© program provides pre- and post-processing functions for the FSI procedure, such as geometry creation, finite element mesh generation, material property definition, and boundary condition application. Several of the pre-processing functions were created exclusively for FSI solutions. The FEM Builder© program provides interfaces to other finite element pre/postprocessors and a number of analysis programs. Scripted access to FEM Builder© program functions is provided through the FEM Python module. The FEM Python module functions provide the basis of the FSI procedure.

The FEM Builder© FSI procedure is applied to the analysis of a fictitious solid rocket motor. The problem of bore choking is examined in order to demonstrate the capabilities of the FSI procedure on a problem with potentially large structural deformations. An overview of the input required by the FSI procedure to solve this problem is discussed.

This work was performed under contract no. F04611-99-C-0002 with the AFRL/PRSB, 4 Draco Dr., Edwards AFB CA 93524-7160.